# Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/GB05/001048

International filing date: 18 March 2005 (18.03.2005)

Document type: Certified copy of priority document

Document details: Country/Office: GB
Number: 0406080.2
Filing date: 18 March 2004 (18.03.2004)

Date of receipt at the International Bureau: 26 May 2005 (26.05.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

PCT/GB 2005 / 0 0 1 0 4 8

10 MAY 2005

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated 14 April 2005

Patents Form 1/77

Patents Act 1977
(Rule 16)

18 MAR 2004

THE PATENT OFFICE
C
18 MAR 2004
NEWPORT

1/77

# Request for grant of a patent

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — 2040-P152-GB

2. Patent application number *(The Patent Office will fill this part in)* — 0406080.2

18MAR04 E881963-3 D03028
P01/7700 0.00-0406080.2 ACCOUNT CHA

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

ELEKSEN LIMITED
Charter Court
Midland Road
Hemel Hempstead
Hertfordshire HP2 5GE
United Kingdom

Patents ADP number *(if you know it)* 08288920001

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention — SENSOR ASSEMBLY

5. Name of your agent *(if you have one)* — ATKINSON BURRINGTON

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

28 President Buildings
President Way
Sheffield
S4 7UR

Patents ADP number — 7807043001

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

| Country | Priority application number *(if you know it)* | Date of filing *(day / month / year)* |
|---|---|---|
| N/A | N/A | N/A |

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute.

| Number of earlier application | Date of filing *(day / month / year)* |
|---|---|
| N/A | N/A |

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request? — YES

Answer YES if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
Otherwise answer NO

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

| | |
|---|---|
| Continuation sheets of this form | 00 |
| Description | 09 |
| Claim(s) | 02 |
| Abstract | 00 |
| Drawing(s) | 04 + 4 fm |

10. If you are also filing any of the following, state how many against each item.

| | |
|---|---|
| Priority documents | N/A |
| Translations of priority documents | N/A |
| Statement of inventorship and right to grant of a patent *(Patents Form 7/77)* | NONE |
| Request for preliminary examination and search *(Patents Form 9/77)* | NONE |
| Request for substantive examination *(Patents Form 10/77)* | NONE |
| Any other documents *(please specify)* | NONE |

11. I/We request the grant of a patent on the basis of this application.

Signature(s) C Atkinson Date **Wednesday, 17 March 2004**

12. Name, daytime telephone number and email address, if any, of person to contact in the United Kingdom

**RALPH ATKINSON CPA**
**0114 275 2400**

# Sensor Assembly

## Background of the Invention

### 1. Field of the Invention

The present invention relates to a sensor, in particular to the assembly of a sensor comprising a plurality of textile layers.

### 2. Description of the Related Art

An example of a fabric sensor comprising a plurality of conductive textile layers is described in international patent publication WO 00/072239, assigned to the present Assignee, the content of which is incorporated herein by reference.

A factor in the particular construction of a sensor utilising conductive textile layers is the prevention of unwanted electrical contact within the sensor, for example resulting from insufficient separation between conductive layers or from frayed edges of a conductive textile layer.

A further example of a mechanical contact apparatus and a method of production is described in United Kingdom patent publication GB 2 386 339 A. According to the method of production described in this publication, individual layers are brought together in a stack arrangement to form an assembly, whereafter a sealing process is performed during which the edges of the assembly are encapsulated within an applied material.

**Brief Summary of the Invention**

According to a first aspect of the present invention there is provided a sensor comprising a plurality of layers in a layer assembly order, said layer assembly order comprising a subassembly comprising: a mask, a conductive textile layer positioned directly upon the mask and conductive tracking positioned such that a portion thereof is positioned directly upon the mask and a portion thereof is positioned directly upon the conductive textile layer.

According to a second aspect of the present invention there is provided a sensor comprising a plurality of layers in a layer assembly order, said layer assembly order comprising a first mask layer, a second mask layer and a third mask layer disposed between said first and second mask layers, each mask layer having adhesive on at least one side thereof; and at least one conductive layer; wherein said mask layers are oriented within the layer assembly order such that under the application of heat and pressure, at least one of said first and second mask layers adheres to both of the other mask layers.

According to a third aspect of the present invention there is provided a sensor comprising a plurality of layers in a layer assembly order, said layer assembly order comprising a first mask layer, a second mask layer and a third mask layer disposed between said first and second masks in which said third mask layer has smaller border dimensions than said first and second mask layers.

## Brief Description of the Several Views of the Drawings

*Figure 1* is a flow chart illustrating a layer assembly order for a sensor;

*Figure 2* shows an exploded view of the component layers of a sensor having the layer assembly order of *Figure 1*;

*Figure 3* illustrates two subassemblies of the sensor of *Figure 2*;

*Figure 4* illustrates an assembly technique of the component layers of the sensor of *Figure 2*.

## Written Description of the Best Mode for Carrying Out the Invention

### *Figure 1*

*Figure 1* is a flow chart illustrating a layer assembly order for a sensor. In this example, the sensor is configured to generate signals in response to mechanical interactions, the signals representing X,Y co-ordinate data of mechanical interactions within the sensing area thereof.

At step **101**, a first mask layer (base mask) is positioned to receive further layers thereon. At step **102**, a first conductive textile layer is placed upon the first mask layer (base layer). At step **103**, first conductive tracking is located upon the first conductive textile layer. At step **104**, a second mask layer (intermediate mask) is positioned over the first conductive textile layer and first conductive tracking, as described in further detail below with reference to *Figure 2*. At step **105** a partially insulating mesh separator layer

is located upon the second mask layer (intermediate mask). At step **106** a second conductive textile layer is placed over the mesh separator layer and at step **107** second conductive tracking is located upon the second conductive layer. At step **108** a third mask layer (top mask) is positioned over the second conductive textile layer and second conductive tracking to complete the layer assembly. In alternative layer assembly orders the conductive tracking may be laid down before or after the adjacent conductive textile layer.

***Figure 2***

An example of a sensor having the layer assembly order outlined in *Figure 1* is shown in *Figure 2*, showing an exploded view of the component layers of sensor **201**.

Sensor **201** comprises three mask layers **202**, **203** and **204**. Each of these layers is fabricated from a polyurethane material coated on one side with a thermoplastic adhesive. Suitable material is sold under the trade mark Nylemark by Victory Designs Limited UK. Preferably, the melting point of the thermoplastic is within the range fifty degrees Celsius to one hundred and fifty degrees Celsius, more preferably approximately one hundred and twenty degrees Celsius.

Top mask **202** and base mask **204** are continuous layers of substantially the same dimensions and at least these two mask layers have an electrical connection mounting tab, for example tab **205** of mask layer

**202**. Intermediate mask **203** defines an aperture, or window, and has smaller dimensions in both axes than both top mask **202** and base mask **204**.

Sensor **201** comprises two conductive textile layers, **206** and **207**, which in this example are of substantially the same construction. The conductive textile layers **206**, **207**, which have electrically conductive fibres incorporation therein, preferably have a woven or knitted construction, but may have a felt or other non-woven construction or a composite construction. The electrically conductive fibre may be for example, carbon coated fibre or carbon impregnated nylon 6 fibre.

Within sensor **201**, a set of conductive tracks is located upon each conductive textile layer. The conductive tracks **208**, **209** are metallised fabric, for example fabric coated with nickel or silver. Conductive tracks **208**, associated with conductive textile layer **206**, are configured to allow a voltage gradient to be established across the conductive textile layer **206** in a first direction across the sensor **201**. Similarly, conductive tracks **209**, associated with conductive textile layer **207**, are configured to allow a voltage gradient to be established across the conductive textile layer **207**, but in a second perpendicular direction across the sensor **201**.

The final layer in the assembly is a partially insulating mesh separator layer **210**. The term mesh is used to refer to a layer defining a plurality of apertures therein. This layer is configured to space the conductive textile layers **206**, **207** apart when no pressure is applied to the sensor **201** and to allow electrical contact between the layers **206**, **207** therethrough during a

mechanical interaction.

Of the layers in the assembly of sensor **201**, top mask **202** and base mask **204** have the greatest border dimensions. Intermediate mask **203** has smaller border dimensions and the conductive textile layers **206**, **207**, and the separator layer **210** are of the same or smaller dimensions, such that the conductive textile layers **206**, **207**, and the separator layer **210** are dimensioned to fit within the border region around the window of intermediate mask **203**.

*Figure 3*

The arrangement of the conductive tracks **208**, **209** with respect to neighbouring layers is illustrated in *Figure 3*.

*Figure 3* shows a first subassembly **301** comprising top mask **202**, conductive textile layer **206** and conductive tracks **208**, and a second subassembly **302** comprising base mask **204**, conductive textile layer **207** and conductive tracks **209**. It can be seen that in each subassembly, the conductive tracks run from the electrical connection mounting tab around on the mask and then from the mask directly onto the conductive textile layer. In this example, the tracks are positioned one on each of opposite sides of the conductive textile layer. Thus, the masks each function as a substrate for portions of the conductive tracks.

***Figure 4***

An assembly technique of the component layers of sensor **201** is illustrated in *Figure 4.* The orientation of top mask **202** is such that adhesive side **401** is facing downwards towards base mask **204**, and the orientation of both intermediate mask **203** and base mask **204** is such that the adhesive side of each, **402** and **403** respectively, is facing upwards towards top mask **202**.

With this arrangement, under the application of heat and pressure, base mask **204** bonds to intermediate mask **203**, indicated by arrow **404**, encapsulating second conductive textile layer **207** and second conductive tracks **209** therebetween. Similarly, intermediate mask **203** and top mask **202** bond together, indicated by arrow **405**, encapsulating first conductive textile layer **206**, first conductive tracks **208** and separator layer **210** therebetween. Due to the border dimensions of top mask **202** and base mask **204** being greater than that of the other component layers, top mask **202** and base mask **204** bond together, indicated by arrow **406**. This action seals the layer assembly together.

The masks of the layer assembly may provide more than one of the following functions: to provide insulation to prevent unwanted electrical contact within the assembly and/or to bond layers together and/or to provide a substrate for other components within the assembly and/or to protect the sensor against ingress of moisture or other contaminants and/or to provide an additional non-conductive area outside the sensing area of the sensor to

allow, for example, the sensor to be physically connected to a case or other device.

To facilitate mounting of the sensor, for example by stapling, it is convenient for the sensor to have an extended, and in this example inactive, border around the edge of the sensor. To provide a stiff, robust edge, the footprint of the separator layer is extended beyond that of the conductive textile layers. The base mask and top mask then attach to each other through the separator layer during assembly.

In an alternative embodiment of the sensor, the top mask and the bottom mask each define an aperture, or window. This feature allows the sensor to breathe. According to a variant embodiment, the intermediate mask defines a plurality of apertures in place of a single window.

Alternatively, or in addition, one or more of the masks in the sensor has adhesive on both sides thereof. According to an embodiment of the sensor, the intermediate mask has adhesive on both sides thereof. This facilitates assembly of the component layers. In a further alternative embodiment of sensor, the top mask and base mask each have adhesive on both sides thereof. This feature facilitates the assembly of the sensor into another assembly, for example a car door panel.

It is to be appreciated that textile layers are prone to fraying following cutting, therefore appropriate allowances should be incorporated into the production of the sensor. A fraying tolerance should be assigned to the conductive textile layers and to the conductive tracking, and the fraying

tolerances should be taken into account when organising these layers on a mask.

A practical application for such a sensor is a strip sensor used with a chair having a motorised moving component mechanism. The sensor is attached to the leading edge of the moving component, which may be located on the underside of the motorised chair, and is configured to provide input data to the motor control of the moving component mechanism. This arrangement provides a safety function to prevent the mechanism closing on an obstacle, such as an animal or a child. In a safety mode of operation, the sensor detects an obstacle in the path of the moving component and the motor control responds to stop movement of the moving component continuing in the same direction, to prevent crushing or trapping of the obstacle.

## Claims

**1.** A sensor comprising a plurality of layers in a layer assembly order, said layer assembly order comprising a subassembly comprising:

a mask, a conductive textile layer positioned directly upon the mask and conductive tracking positioned such that a portion thereof is positioned directly upon the mask and a portion thereof is positioned directly upon the conductive textile layer.

**2.** A sensor comprising a plurality of layers in a layer assembly order, said layer assembly order comprising a first mask layer, a second mask layer and a third mask layer disposed between said first and second mask layers, each mask layer having adhesive on at least one side thereof; and

at least one conductive layer; wherein

said mask layers are oriented within the layer assembly order such that under the application of heat and pressure, at least one of said first and second mask layers adheres to both of the other mask layers.

**3.** A sensor according to claim **2** in which said third mask layer has smaller border dimensions than said first and second mask layers.

**4.** A sensor according to claim **2** or claim **3** in which said third

mask layer defines a window.

**5.** A sensor according to any preceding claim configured to generate signals in response to mechanical interactions, the signals representing X,Y co-ordinate data of mechanical interactions.

**6.** A sensor substantially as herein described with reference to and as shown in *Figures 1 to 4* of the accompanying drawings.

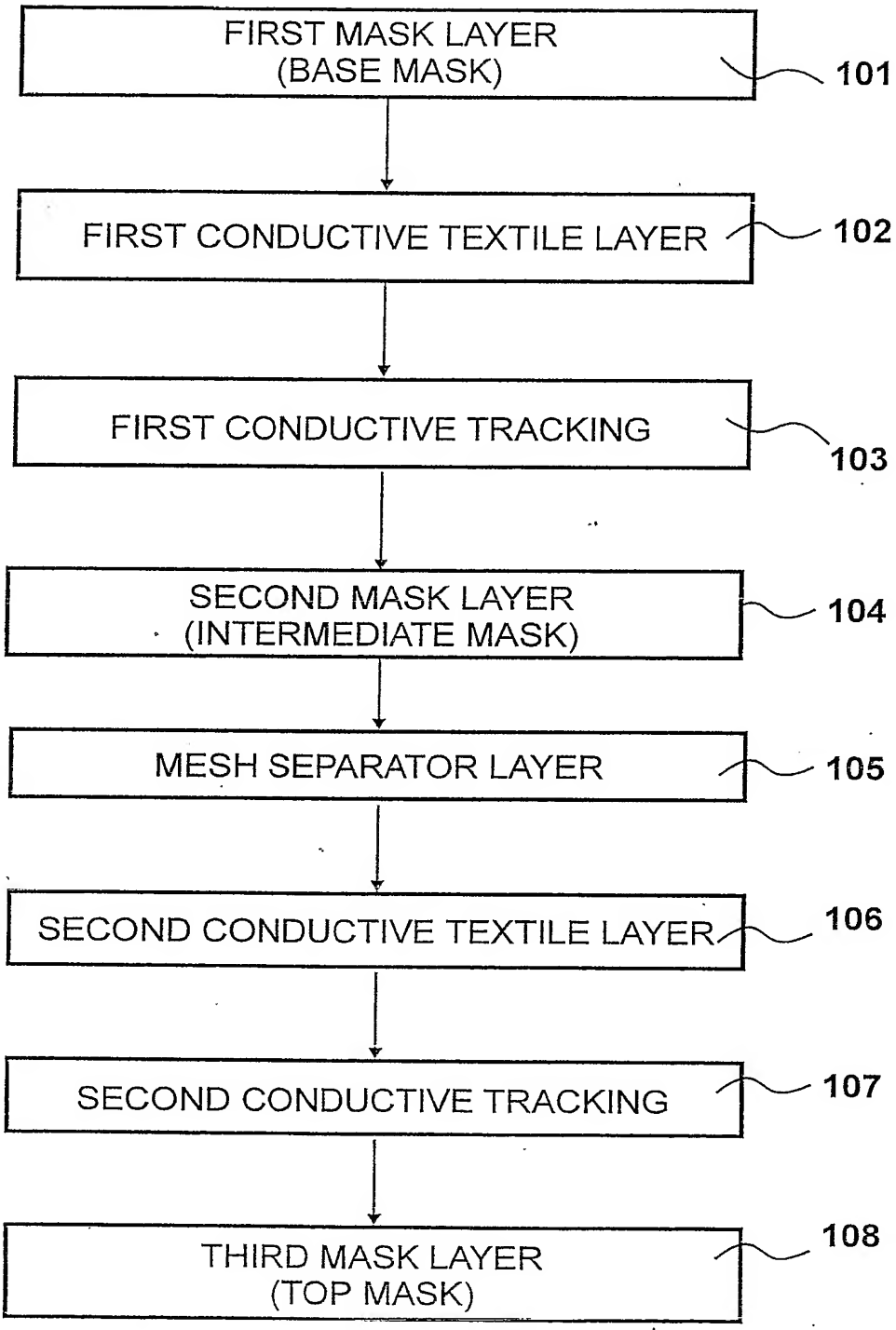

FIRST MASK LAYER
(BASE MASK)
101
FIRST CONDUCTIVE TEXTILE LAYER
102
FIRST CONDUCTIVE TRACKING
103
SECOND MASK LAYER
(INTERMEDIATE MASK)
104
MESH SEPARATOR LAYER
105
SECOND CONDUCTIVE TEXTILE LAYER
106
SECOND CONDUCTIVE TRACKING
107
THIRD MASK LAYER
(TOP MASK)
108

*Figure 1*

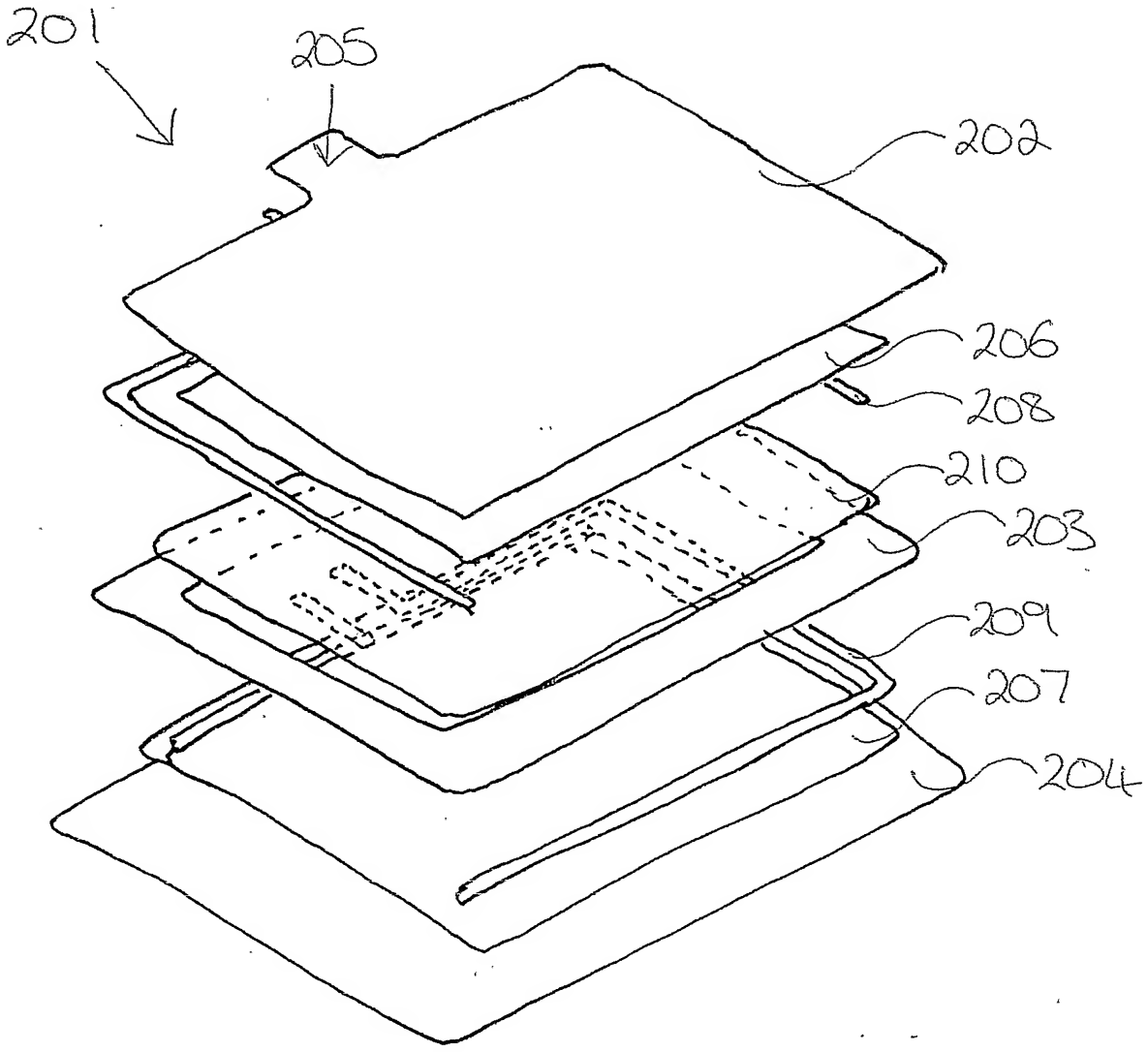
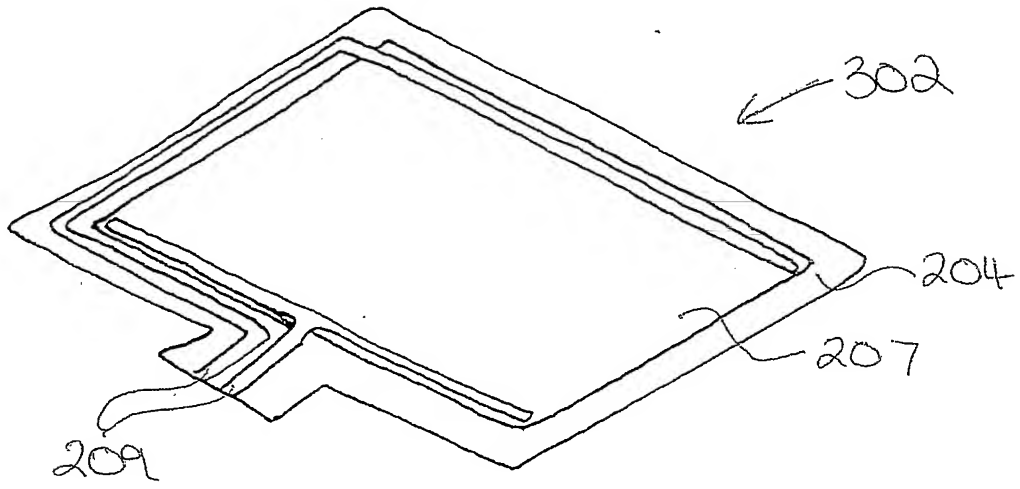



FIGURE 2



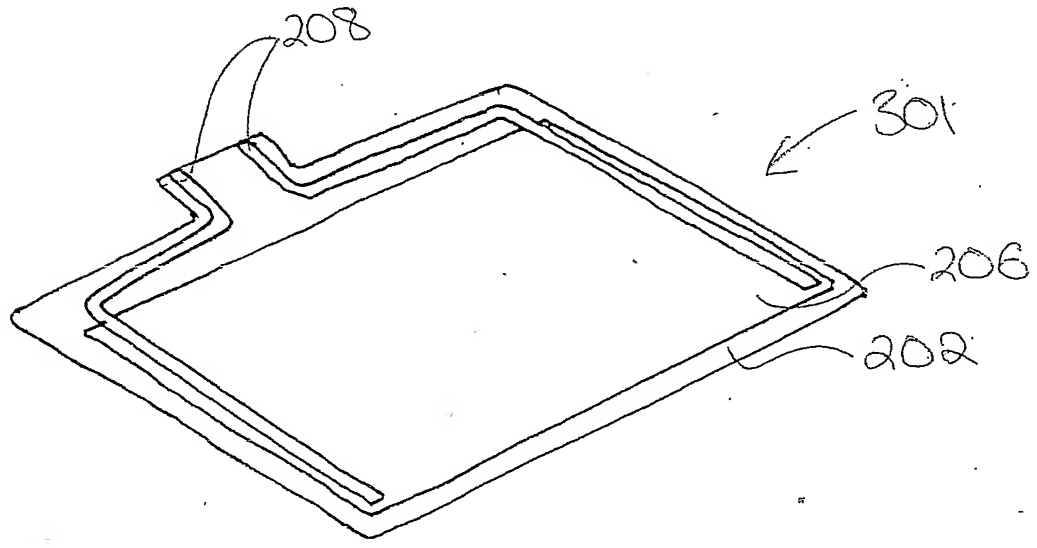




FIGURE 3

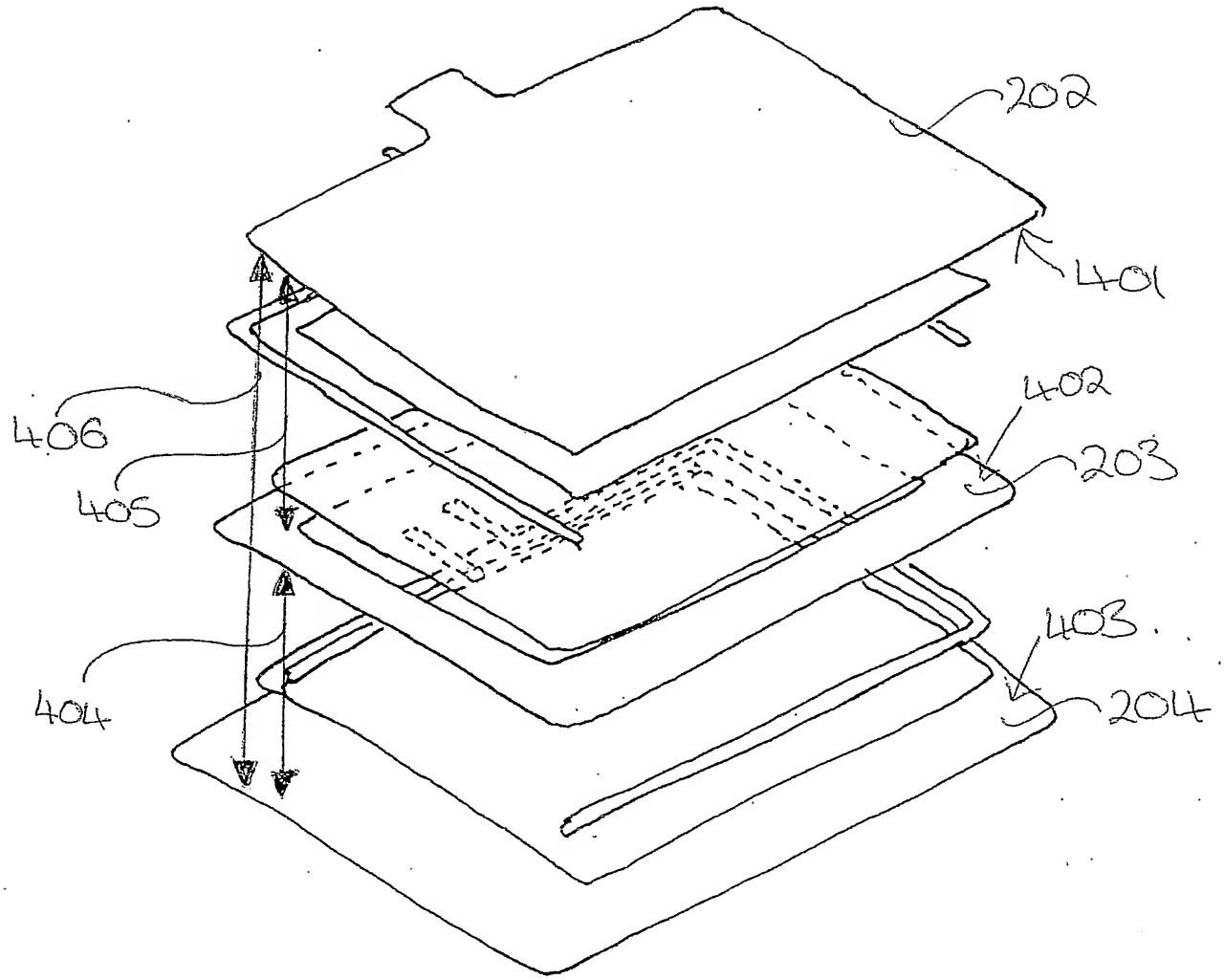



FIGURE 4.